

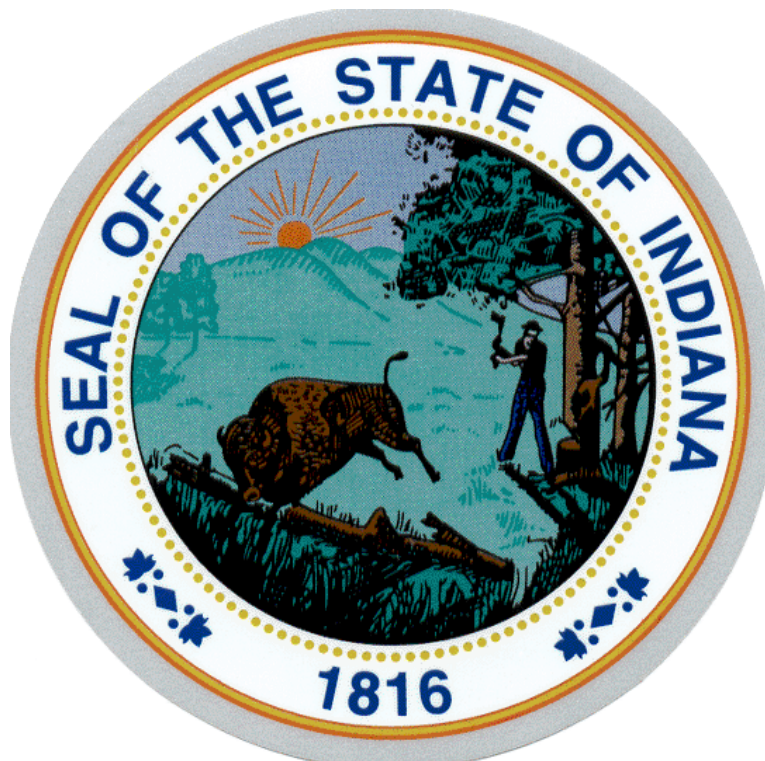
Indiana Department of  
**Labor**



# Bureau of Mines

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## MINE FOREMAN'S STUDY GUIDE



## **QUALIFICATIONS**

- **Must hold an Indiana Miners License**
- **Applicant for Mine Foreman must be a citizen of the United States.**
- **Must have four (4) years experience in underground coal mining.**
  - **However: persons who have graduated and hold a degree in engineering or an approved four (4) year program in coal mining technology from an accredited school, college or university are required to have only two (2) years of practical underground mining experience to qualify for the examination and persons who have graduated and hold a two (2) year associate in applied science degree in coal mining technology from an accredited school, college or university are required to have only three (3) years practical underground mining experience to qualify for the examination.**
- **Thorough knowledge of the coal mining laws in Indiana, and the mining laws under Title 30 CFR, and the Federal Mine Safety and Health Act of 1977 Amended by the MINER ACT Of 2006.**
- **Prove to the Mining Board by a written and oral examination, and by demonstration that you are competent and qualified where applicable, that he has a thorough knowledge of:**
  - **The theory and practice of coal mining;**
  - **The nature and properties of poisonous, noxious, and explosive gases and methods for their detection and control;**
  - **The requirements of the coal mining laws of this state.**
- **A certificate of competency may not be issued to any person whose grade is less than 75%.**
- **Applicants for examination must pay the Bureau of Mines an examination fee of \$25.00.**

## **PURPOSE**

- Each commercial mine shall be supervised by a properly certified mine foreman who shall see that the provisions of the coal-mining laws of Indiana that pertain to his duties and to the health and safety of the employees are complied with. When the mine workings are so extensive that the mine foreman is unable personally to carry out the duties required of him by law, the operator shall employ a sufficient numbers of properly certified assistants who shall act under the direction of the mine foreman. The mine foreman or his assistants shall not permit any person to work in an unsafe place except for the purpose of making it safe and such work shall be under the direction and instruction of a certified official.
- The mine foreman shall provide such data and information regarding the operation of the mine as may be required by the Director on blanks which shall be furnished by the Director. He is responsible for the health and safety of all employees. He must see that adequate supplies are on hand for the safe operation of the mine. He must read and countersign all mine record books (promptly). He shall see that there are properly certified mine examiners to insure proper pre-shift and on-shift inspections. He must insure adequate and proper ventilation. He is responsible to insure that all mining laws are complied with.

## **MINING TERMS**

**Act:** The Federal Mine Safety and Health Act of 1977.

**Abandoned Workings:** Means excavations, either caved or sealed, that are deserted and in which further mining is not intended, open workings which are not ventilated and inspected regularly, and from which all material has been removed.

**Active workings:** Any place in a coal mine where miners are normally required to work or travel.

**Air course:** An entry or a set of entries separated from other entries by stoppings, overcasts, other ventilation control devices, or by solid blocks of coal or rock so that any mixing of air currents between each is limited to leakage.

**Assistant Mine Foreman:** Means a person employed to assist the mine foreman in the performance of his duties and to serve in his place, in the absence of the mine foreman.

**Coal dust:** Particles of coal that can pass a No. 20 sieve.

**Director:** Means the director of the bureau of mines and mining of Indiana.

**Float coal dust:** Coal dust consisting of particles of coal that can pass a No. 200 sieve.

**Intake air:** Air that has not yet ventilated the last working place on any split of any working section, or any worked-out area, whether pillared or nonpillared.

**Interested Persons:** Means the director, safety personnel designated by the operator, state and federal coal mine inspectors, and to the extent required by law, any other person.

**Loose coal:** Coal fragments larger in size than coal dust.

**Man or men:** As used in this article includes woman and women. The masculine gender includes the feminine, the feminine, the masculine.

**Mine:** means an underground commercial coal mine.

**Mine Examiner:** Means a properly certified person designated by the mine foreman to examine the mine for gas and other dangers.

**Mine Inspector:** Means the person appointed to assist in administering this article.

**Operator:** Means an individual, firm, association, partnership or corporation operating an underground coal mine or any part thereof.

**Overcast:** Is an enclosed structure that permits one air current to cross over another. It allows an uninterrupted flow of air and eliminates the need for doors.

**Person:** Includes natural persons, corporations, partnerships, and any other legal entity.

**Qualified person:** As the context requires:

**Return air:** Air that has ventilated the last working place on any split of any working section or any worked-out area whether pillared or nonpillared. If air mixes with air that has ventilated the last working place on any split of any working section or any worked-out area, whether pillared or nonpillared, it is considered return air. For the purposes of §75.507-1, air that has been used to ventilate any working place in a coal producing section or pillared area, or air that has been used to ventilate any working face if such air is directed away from the immediate return is return air. Notwithstanding the definition of intake air, for the purpose of ventilation of structures, areas or installations that are required by this subpart D to be ventilated to return air courses, and for ventilation of seals, other air courses may be designated as return air courses by the operator only when the air in these air courses will not be used to ventilate working places or other locations, structures, installations or areas required to be ventilated with intake air.

**Rock dust:** Pulverized limestone, dolomite, gypsum, anhydrite, shale, adobe, or other inert material, preferably light colored, 100 percent of which will pass through a sieve having 20 meshes per linear inch and 70 percent or more of which will pass through a sieve having 200 meshes per linear inch; the particles of which when wetted and dried will not cohere to form a cake which will not be dispersed into separate particles by a light blast of air; and which does not contain more than 5 percent combustible matter or more than a total of 4 percent free and combined silica ( $\text{SiO}_2$ ), or, where the Secretary finds that such silica concentrations are not available, which does not contain more than 5 percent of free and combined silica.

**Shot Firer.** Means a properly certified person designated by the mine foreman to perform the function as required in this article in connection with breaking down coal or rock.

**Substation.** An electrical installation containing generation or power conversion equipment and associated electric equipment and parts, such as switchboards, switches, wiring, fuses, circuit breakers, compensators, and transformers.

**Undercast.** Is an enclosed structure that permits one air current to pass under another. They allow for uninterrupted flow of air and eliminates the need for doors.

- Overcast and undercast shall be constructed tightly of incombustible material; they shall be of ample area to pass the required quantity of air and shall be kept clear of obstructions.

**Worked-out area:** An area where mining has been completed, whether pillared or nonpillared, excluding developing entries, return air courses, and intake air courses.

**Working face:** Any place in a coal mine in which work of extracting coal from its natural deposit in the earth is performed during the mining cycle.

**Working place:** The area of a coal mine in by the last open crosscut.

**Working section:** All areas of the coal mine from the loading point of the section to and including the working faces.

## **EXAMINATIONS**

### **Weekly**

- (b) *Hazardous conditions.* At least every 7 days, an examination for hazardous conditions at the following locations shall be made by a certified person designated by the operator:
  - (5) In each escapeway so that the entire escapeway is traveled.
- (c) *Measurements and tests.* At least every 7 days, a certified person shall—
  - (1) Determine the volume of air entering the main intakes and in each intake split;
  - (2) Determine the volume of air and test for methane in the last open crosscut in any pair or set of developing entries or rooms, in the return of each split of air immediately before it enters the main returns, and where the air leaves the main returns; and
  - (3) Test for methane in the return entry nearest each set of seals immediately after the air passes the seals.
- (h) *Recordkeeping.* At the completion of any shift during which a portion of a weekly examination is conducted, a record of the results of each weekly examination, including a record of hazardous conditions found during each examination and their locations, the corrective action taken, and the results and location of air and methane measurements, shall be made. The results of methane tests shall be recorded as the percentage of methane measured by the examiner. The record shall be made by the person making the examination or a person designated by the operator. If made by a person other than the examiner, the examiner shall verify the record by the initials and date by or at the end of the shift for which the examination was made. The record shall be countersigned by the mine foreman or equivalent mine official by the end of the mine foreman's or equivalent mine official's next regularly scheduled working shift. The records required by this section shall be made in a secure book that is not susceptible to alteration or electronically in a computer system so as to be secure and not susceptible to alteration.

## **EXAMINATIONS**

### **On-shift**

- (d)(1) A qualified person shall make tests for methane–
  - (i) At the start of each shift at each working place before electrically operated equipment is energized; and
  - (ii) Immediately before equipment is energized, taken into, or operated in a working place; and
  - (iii) At 20-minute intervals, or more often if required in the approved ventilation plan at specific locations, during the operation of equipment in the working place.

## **SMOKING PROHIBITION**

- No person shall smoke, carry smoking materials, matches, or lighters underground, or smoke in or around oil houses, explosives magazines, or other surface areas where such practice may cause a fire or explosion. The operator shall institute a program, approved by the Secretary, to insure that any person entering the underground area of the mine does not carry smoking materials, matches, or lighters.

## **FIRE PROTECTION**

- **Requirements**
  - Each coal mine shall be provided with suitable firefighting equipment adapted for the size and conditions of the mine. The Secretary shall establish minimum requirements of the type, quality, and quantity of such equipment.
- **Type and quality of firefighting equipment.**
  - Firefighting equipment required under this subpart shall meet the following minimum requirements:
  - (a) Waterlines: Waterlines shall be capable of delivering 50 gallons of water a minute at a nozzle pressure of 50 pounds per square inch.



## **ESCAPEWAYS**

- (a) Except in situations addressed in §75.381, §75.385 and §75.386, at least two separate and distinct travelable passageways shall be designated as escapeways and shall meet the requirements of this section.
- (b) (1) Escapeways shall be provided from each working section, and each area where mechanized mining equipment is being installed or removed, continuous to the surface escape drift opening or continuous to the escape shaft or slope facilities to the surface.
  - (2) During equipment installation, these escapeways shall begin at the projected location for the section loading point. During equipment removal, they shall begin at the location of the last loading point.
- (c) The two separate and distinct escapeways required by this section shall not end at a common shaft, slope, or drift opening, except that multiple compartment shafts or slopes separated by walls constructed of noncombustible material may be used as separate and distinct passageways.
- (d) Each escapeway shall be—
  - (1) Maintained in a safe condition to always assure passage of anyone, including disabled persons;
  - (2) Clearly marked to show the route and direction of travel to the surface;
  - (3) Maintained to at least a height of 5 feet from the mine floor to the mine roof, excluding the thickness of any roof support, except that the escapeways shall be maintained to at least the height of the coalbed, excluding the thickness of any roof support, where the coalbed is less than 5 feet. In areas of mines where escapeways pass through doors, the height may be less than 5 feet, provided that sufficient height is maintained to enable miners, including disabled persons, to escape quickly in an emergency. In areas of mines developed before November 16, 1992, where escapeways pass over or under overcasts or undercasts, the height may be less than 5 feet provided that sufficient height is maintained to enable miners, including disabled persons, to escape quickly in an emergency. When there is a need to determine whether sufficient height is provided, MSHA may require a stretcher test where 4 persons carry a miner through the area in question on a stretcher;

- (4) Maintained at least 6 feet wide except—
  - (i) Where necessary supplemental roof support is installed, the escapeway shall not be less than 4 feet wide; or
  - (ii) Where the route of travel passes through doors or other permanent ventilation controls, the escapeway shall be at least 4 feet wide to enable miners to escape quickly in an emergency, or
  - (iii) Where the alternate escapeway passes through doors or other permanent ventilation controls or where supplemental roof support is required and sufficient width is maintained to enable miners, including disabled persons, to escape quickly in an emergency. When there is a need to determine whether sufficient width is provided, MSHA may require a stretcher test where 4 persons carry a miner through the area in question on a stretcher, or
  - (iv) Where mobile equipment near working sections, and other equipment essential to the ongoing operation of longwall sections, is necessary during normal mining operations, such as material cars containing rock dust or roof control supplies, or is to be used for the evacuation of miners off the section in the event of an emergency. In any instance, escapeways shall be of sufficient width to enable miners, including disabled persons, to escape quickly in an emergency. When there is a need to determine whether sufficient width is provided, MSHA may require a stretcher test where 4 persons carry a miner through the area in question on a stretcher;
- (5) Located to follow the most direct, safe and practical route to the nearest mine opening suitable for the safe evacuation of miners; and
- (6) Provided with ladders, stairways, ramps, or similar facilities where the escapeways cross over obstructions.
- (7) Provided with a continuous, durable directional lifeline or equivalent device that shall be—
  - (i) Installed and maintained throughout the entire length of each escapeway as defined in paragraph (b)(1) of this section;
  - (ii) Flame-resistant in accordance with the requirements of part 18 of this chapter upon replacement of existing lifelines; but in no case later than June 15, 2009;

- (iii) Marked with a reflective material every 25 feet;
- (iv) Located in such a manner for miners to use effectively to escape;
- (v) Equipped with one directional indicator cone securely attached to the lifeline, signifying the route of escape, placed at intervals not exceeding 100 feet. Cones shall be installed so that the tapered section points inby;
- (vi) Equipped with one sphere securely attached to the lifeline at each intersection where personnel doors are installed in adjacent crosscuts;
- (vii) Equipped with two securely attached cones, installed consecutively with the tapered section pointing inby, to signify an attached branch line is immediately ahead. (A) A branch line leading from the lifeline to an SCSR cache will be marked with four cones with the base sections in contact to form two diamond shapes. The cones must be placed within reach of the lifeline. (B) A branch line leading from the lifeline to a refuge alternative will be marked with a rigid spiraled coil at least eight inches in length. The spiraled coil must be placed within reach of the lifeline (see Illustration 1 next page).

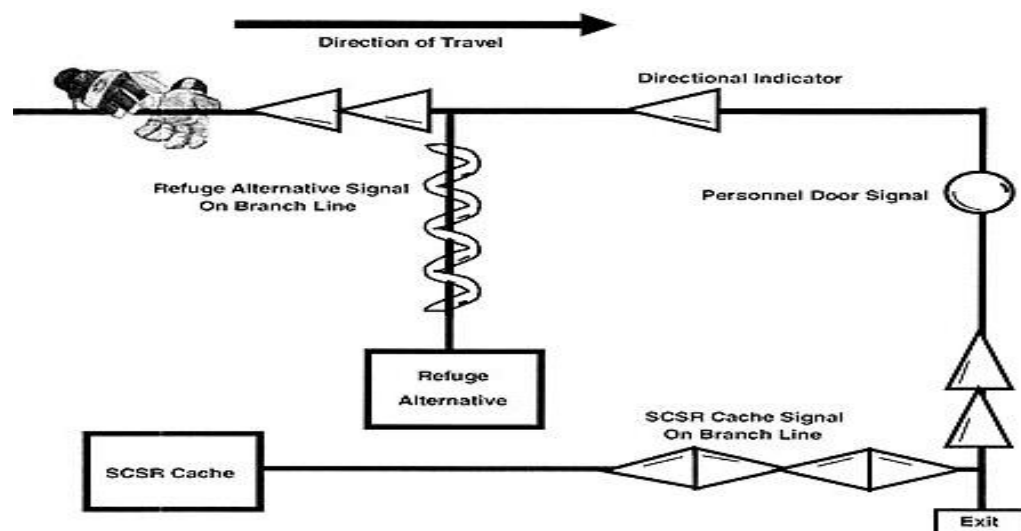


Illustration 1

- (e) Surface openings shall be adequately protected to prevent surface fires, fumes, smoke, and flood water from entering the mine.
- (f) *Primary escapeway.* (1) One escapeway that is ventilated with intake air shall be designated as the primary escapeway. The primary

escapeway shall have a higher ventilation pressure than the belt entry unless the mine operator submits an alternative in the mine ventilation plan to protect the integrity of the primary escapeway, based on mine specific conditions, which is approved by the district manager.

- (2) Paragraphs (f)(3) through (f)(7) of this section apply as follows:
  - (i) To all areas of a primary escapeway developed on or after November 16, 1992;
  - (ii) Effective as of June 10, 1997, to all areas of a primary escapeway developed between March 30, 1970 and November 16, 1992; and
  - (iii) Effective as of March 11, 1997, to all areas of the primary escapeway developed prior to March 30, 1970 where separation of the belt and trolley haulage entries from the primary escapeway existed prior to November 16, 1992.
- (3) The following equipment is not permitted in the primary escapeway:
  - (i) Mobile equipment hauling coal except for hauling coal incidental to cleanup or maintenance of the primary escapeway.
  - (ii) Compressors, except—
    - (A) Compressors necessary to maintain the escapeway in safe, travelable condition;
    - (B) Compressors that are components of equipment such as locomotives and rock dusting machines; and
    - (C) Compressors of less than five horsepower.
  - (iii) Underground transformer stations, battery charging stations, substations, and rectifiers except
    - (A) Where necessary to maintain the escapeway in safe, travelable condition; and
    - (B) Battery charging stations and rectifiers and power centers with transformers that are either dry-type or contain nonflammable liquid, provided they are located on or near a working section and are moved as the section advances or retreats.
  - (iv) Water pumps, except—
    - (A) Water pumps necessary to maintain the escapeway in safe, travelable condition;
    - (B) Submersible pumps;
    - (C) Permissible pumps and associated permissible switchgear;

- (D) Pumps located on or near a working section that are moved as the section advances or retreats;
  - (E) Pumps installed in anthracite mines; and
  - (F) Small portable pumps.
- (4) Mobile equipment operated in the primary escapeway, except for continuous miners and as provided in paragraphs (f)(5), (f)(6), and (f)(7) of this section, shall be equipped with a fire suppression system installed according to §§75.1107-3 through 75.1107-16 that is—
  - (i) Manually operated and attended continuously by a person trained in the systems function and use, or
  - (ii) A multipurpose dry chemical type capable of both automatic and manual activation.
- (5) Personnel carriers and small mobile equipment designed and used only for carrying people and small hand tools may be operated in primary escapeways if—
  - (i) The equipment is provided with a multipurpose dry chemical type fire suppression system capable of both automatic and manual activation, and the suppression system is suitable for the intended application and is listed or approved by a nationally recognized independent testing laboratory, or,
  - (ii) Battery powered and provided with two 10 pound multipurpose dry chemical portable fire extinguishers.
- (6) Notwithstanding the requirements of paragraph (f)(3)(i), mobile equipment not provided with a fire suppression system may operate in the primary escapeway if no one is in by except those persons directly engaged in using or moving the equipment.
- (7) Notwithstanding the requirements of paragraph (f)(3)(i), mobile equipment designated and used only as emergency vehicles or ambulances, may be operated in the primary escapeway without fire suppression systems.
- (g) Except where separation of belt and trolley haulage entries from designated escapeways did not exist before November 15, 1992, and except as provided in § 75.350(c), the primary escapeway must be separated from belt and trolley haulage entries for its entire length, to and including the first connecting crosscut outby each loading point except when a greater or lesser distance for this separation is specified and approved in the mine ventilation plan and does not pose a hazard to miners.

- (h) *Alternate escapeway*. One escapeway shall be designated as the alternate escapeway. The alternate escapeway shall be separated from the primary escapeway for its entire length, except that the alternate and primary escapeways may be ventilated from a common intake air shaft or slope opening.
- (i) Mechanical escape facilities shall be provided and maintained for—
  - (1) Each shaft that is part of a designated escapeway and is greater than 50 feet in depth; and
  - (2) Each slope from the coal seam to the surface that is part of a designated escapeway and is inclined more than 9 degrees from the horizontal.
- (j) Within 30 minutes after mine personnel on the surface have been notified of an emergency requiring evacuation, mechanical escape facilities provided under paragraph (i) of this section shall be operational at the bottom of shaft and slope openings that are part of escapeways.
- (k) Except where automatically activated hoisting equipment is used, the bottom of each shaft or slope opening that is part of a designated escapeway shall be equipped with a means of signaling a surface location where a person is always on duty when anyone is underground. When the signal is activated or the evacuation of persons underground is necessary, the person shall assure that mechanical escape facilities are operational as required by paragraph (j) of this section.
- (l)(1) Stairways or mechanical escape facilities shall be installed in shafts that are part of the designated escapeways and that are 50 feet or less in depth, except ladders may be used in shafts that are part of the designated escapeways and that are 5 feet or less in depth.
  - (2) Stairways shall be constructed of concrete or metal, set on an angle not to exceed 45 degrees from the horizontal, and equipped on the open side with handrails. In addition, landing platforms that are at least 2 feet by 4 feet shall be installed at intervals not to exceed 20 vertical feet on the stairways and equipped on the open side with handrails.
  - (3) Ladders shall be constructed of metal, anchored securely, and set on an angle not to exceed 60 degrees from the horizontal.
- (m) A travelway designed to prevent slippage shall be provided in slope and drift openings that are part of designated escapeways, unless mechanical escape facilities are installed.

## **Ocenco M-20 Self Contained Self Rescuer**

### **☐ Capabilities:**

- The self contained self rescuer device will provide the wearer protection against irrespirable atmosphere for about ten (10) minutes.

### **☐ Limitations:**

- Cannot be reused (must be discarded or sent back to factory for refurbishment).
- Cannot be substituted for conventional respiratory equipment (gas masks or self-contained breathing apparatus)
- Has a 15 year service life if properly inspected
- Has a 10 year service life if stored properly.
- Has a 5 year service life if worn properly.

### **☐ Inspection**

- Before going underground every miner should examine his self contained self rescuer for any external damage.
- Methods of inspection
  - ☐ Cylinder pressure gauge needle in the green.
  - ☐ Pressure gauge bent or indicator needle is broken.
  - ☐ Case view obstructed or not clear to adequately examine device.
  - ☐ Case cracked, burned, deformed or excessively worn.
  - ☐ Excessive gap between the cover and base.
  - ☐ Tamper indicating ball missing.
  - ☐ Latch or cover band damaged or misaligned.
  - ☐ Dirt, debris or moisture visible through case or the pressure gauge window.
  - ☐ belt loops broken.

### **☐ Donning**

- Release the yellow lever.
- Pull yellow neck strap upward.
- Insert yellow mouthpiece.
- Fit yellow nose clip.
- Fit and adjust yellow neck strap.
- Breathe and escape.

## **CSE SR-100 Self Contained Self Rescuer**

### **☐ Capabilities:**

- The self contained self rescuer device will provide the wearer protection against irrespirable atmosphere for about 1 (1) hour.

### **☐ Limitations:**

- Cannot be reused (must be discarded after use).
- Cannot be substituted for conventional respiratory equipment (gas masks or self-contained breathing apparatus)
- Has a 15 year service life if properly inspected
- Has a 10 year service life if stored properly.
- Has a 5 year service life if worn properly.

### **☐ Inspection**

- Before going underground every miner should examine his self contained self rescuer for any external damage.
- Methods of inspection
  - ☐ Remove from carrying case.
  - ☐ Examine for excessive damage.
  - ☐ Examine moisture indicators.
  - ☐ Examine seals for wear.
  - ☐ Examine heat indicator.
  - ☐ Examine security bands.

### **☐ Donning**

- Kneel.
- Remove hard hat.
- Open latch on the top of the device.
- Remove the top and bottom covers.
- Loop neck strap over head.
- Activate oxygen.
- Insert mouth piece and exhale into bag.
- Fit nose clips.
- Put on goggles.
- Adjust neck strap.
- Fasten and adjust waist strap.
- Replace hard hat.
- Breathe and escape.



## **Ocenco EBA 6.5 Self Contained Self Rescuer**

- ☐ **Capabilities:**
  - The self contained self rescuer device will provide the wearer protection against irrespirable atmosphere for about 1 (1) hour.
- ☐ **Limitations:**
  - Cannot be reused (must be discarded or sent back the factory for refurbishment after use).
  - Cannot be substituted for conventional respiratory equipment (gas masks or self-contained breathing apparatus)
  - Has a 15 year service life if properly inspected
  - Has a 10 year service life if stored properly.
  - Has a 5 year service life if worn properly.
- ☐ **Capabilities:**
  - The self contained self rescuer device will provide the wearer protection against irrespirable atmosphere for about 1 (1) hour.
- ☐ **Limitations:**
  - Cannot be reused (must be discarded or sent back the factory for refurbishment after use).
  - Cannot be substituted for conventional respiratory equipment (gas masks or self-contained breathing apparatus)
  - Has a 15 year service life if properly inspected
  - Has a 10 year service life if stored properly.
  - Has a 5 year service life if worn properly.
- ☐ **Inspection**
  - Before going underground every miner should examine his self contained self rescuer for any external damage.
  - **Methods of inspection**
    - ☐ Examine oxygen pressure gauge is in the green.
    - ☐ Examine latch seals.
    - ☐ Case view obstructed or not clear to adequately examine device.
    - ☐ Case cracked, burned, deformed or excessively worn.
    - ☐ Excessive wear or gap around the cover seals.
    - ☐ Loose or missing parts with the bottle straps.
    - ☐ The on / off valve is positioned towards base.
    - ☐ Red rubber bottle pad is cut or displaced.
    - ☐ Pressure gauge bent or indicator needle is broken.
    - ☐ Scrubber canister not in mounts or is dented.

- ☐ Dirt, debris or moisture visible through case or the pressure gauge window.
- ☐ Plastic handle loops are broken.
- ☐ Handle straps are missing or broken.
- ☐ Yellow mouth piece plug detached from mouth piece.
- ☐ Check the case seals.
- ☐ Donning
  - Kneel.
  - Remove hard hat.
  - Open latch on the top of the device.
  - Remove the latch release and bands.
  - Remove the cover from the base.
  - Open oxygen valve.
  - Loop neck strap over head.
  - Insert mouth piece and exhale into bag.
  - Fit nose clips.
  - Purge bag.
  - Adjust neck strap.
  - Fasten and adjust waist strap.
  - Put on goggles.
  - Replace hard hat.
  - Breathe and escape.

## **MINE EMERGENCY**

- **Mine emergency evacuation training and drills.**
  - Each operator of an underground coal mine shall conduct mine emergency evacuation training and drills and require all miners to participate.
    - (a) *Schedule of training and drills.* Each miner shall participate in a mine emergency evacuation training and drill once each quarter. Quarters shall be based on a calendar year (Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec).

## **ROCK DUSTING**

- All underground areas of a coal mine, except those areas in which the dust is too wet or too high in incombustible content to propagate an explosion, shall be rock dusted to within 40 feet of all working faces, unless such areas are inaccessible or unsafe to enter or unless the Secretary or his authorized representative permits an exception upon his finding that such exception will not pose a hazard to the miners. All crosscuts that are less than 40 feet from a working face shall also be rock dusted.

## **COAL DUST**

1. Is it possible to have an explosion in a mine without explosive gas being present?
  - a. yes, in addition to explosive gas, the fine coal dust deposited on the floor, ribs, roof, and timbers is explosive.
2. What usually causes explosions to spread over a wide area and sometimes extend throughout the mine?
  - a. coal dust
3. How does coal dust contribute to severity of an explosion?
  - a. by being raised in clouds and ignited; the explosion is thus spread through the mine.
4. Is all coal dust explosive?
  - a. all bituminous coal dust and lignite dusts are explosive.
5. What coal dusts are most easily ignited?
  - a. the higher-volatile dusts.
6. How is the fine coal dust distributed throughout the mine?
  - a. it is picked up by the ventilating current and deposited on the ribs, roof, floor, and timbers.
7. How are coal dust explosions most frequently started?
  - a. by explosions of methane, electric arcs, and explosives.

8. How much coal dust is enough to start a coal-dust explosion?
  - a. about one-twelfth of an ounce per cubic foot of air.
9. What are the largest size particles of coal dust that will start an explosion?
  - a. any particle that will pass through a 20-mesh screen.
10. What affect does fineness of coal dust have upon its explicability?
  - a. fineness will increase the explicability.
11. What is the principal explosion hazard in tipples and cleaning plants?
  - a. accumulation of coal dust.
12. What should be done with accumulations of fine, dry coal dust in a mine?
  - a. they should be removed.
13. Which type of mining creates the greatest coal dust hazard?
  - a. the use of continuous type mining machines.
14. Why do the continuous type mining machines create the greatest dust hazard?
  - a. the continuous type machine is a combined unit which produces all phases of operation; cutting, drilling, blasting, and loading; consequently the dust is accumulated in one mass and is released in one location.
15. Should the return air containing large concentrations of coal dust be permitted to pass through active workings?
  - a. no, it should be removed from the air current as near to the source as possible and should not be conducted through the active workings.
16. What is the ignition temperature of coal dust?
  - a. from 970 degree F to 1130 degree F.

## **CONTROL OF COAL DUST, USE OF WATER**

1. Does the use of water in the average mine lessen the hazard of ignition of coal dust?
  - a. only when used frequently to allay fine dust.
2. What is the maximum amount of moisture that coal dust will retain?
  - a. about 20 percent.
3. Will damp coal dust explode?
  - a. yes, dampness causes the dust particles to stick together, and greater force is required to separate them and bring them into suspension. Once in suspension however, if ignited by a flame or an electric arc, they will explode.
4. How can unusual quantities of coal dust be kept out of suspension?
  - a. by sprinkling or other dust-allying methods.

## **CONTROL OF COAL DUST, USE OF ROCK DUST**

1. How should dry and dusty sections be treated?
  - a. the dust should be taken out of the mine. The sections should be kept thoroughly rock dusted.
2. What benefit is derived from rock dusting?
  - a. by decreasing the explosibility of the mine dust, the danger of a coal dust explosion is reduced and the illumination is increased.
3. What parts of a mine should be rock dusted?
  - a. all accessible parts. All sections of the mine that are working out should be heavily rock-dusted before the section is abandoned.

## **ACTIONS FOR EXCESSIVE METHANE**

- (a) *Location of tests.* Tests for methane concentrations under this section shall be made at least 12 inches from the roof, face, ribs, and floor.
- (b) *Working places and intake air courses.*
  - (1) When 1.0 percent or more methane is present in a working place or an intake air course, including an air course in which a belt conveyor is located, or in an area where mechanized mining equipment is being installed or removed—
    - (i) Except intrinsically safe atmospheric monitoring systems (AMS), electrically powered equipment in the affected area shall be deenergized, and other mechanized equipment shall be shut off;
    - (ii) Changes or adjustments shall be made at once to the ventilation system to reduce the concentration of methane to less than 1.0 percent; and
    - (iii) No other work shall be permitted in the affected area until the methane concentration is less than 1.0 percent.
  - (2) When 1.5 percent or more methane is present in a working place or an intake air course, including an air course in which a belt conveyor is located, or in an area where mechanized mining equipment is being installed or removed—
    - (i) Everyone except those persons referred to in §104(c) of the Act shall be withdrawn from the affected area; and
    - (ii) Except for intrinsically safe AMS, electrically powered equipment in the affected area shall be disconnected at the power source.

## **ROOF CONTROL**

- **Roof bolting.**
- (c)(1) A bearing plate shall be firmly installed with each roof bolt.
- (f) *Tensioned roof bolts* (4) In each roof bolting cycle, the actual torque or tension of the first tensioned roof bolt installed with each drill head shall be measured immediately after it is installed. Thereafter, for each drill head used, at least one roof bolt out of every four installed shall be measured for actual torque or tension. If the torque or tension of any of the roof bolts measured is not within the range specified in the roof control plan, corrective action shall be taken.
- (g) *Non-tensioned grouted roof bolts*. The first non-tensioned grouted roof bolt installed during each roof bolting cycle shall be tested during or immediately after the first row of bolts has been installed. If the bolt tested does not withstand at least 150 foot-pounds of torque without rotating in the hole, corrective action shall be taken.
- **Manual installation of temporary support.**
- (a) When manually installing temporary support, only persons engaged in installing the support shall proceed beyond permanent support.
- (c) All temporary supports shall be placed on no more than 5-foot centers.
- **Roof testing and scaling.**
- (a) A visual examination of the roof, face and ribs shall be made immediately before any work is started in an area and thereafter as conditions warrant.
- **Roof support removal.**
- (a)(1) All persons who perform the work of removing permanent roof supports shall be supervised by a management person experienced in removing roof supports.
  - (2) Only persons with at least one year of underground mining experience shall perform permanent roof support removal work.
- **Roof control plan.**
- (a)(1) Each mine operator shall develop and follow a roof control plan, approved by the District Manager, that is suitable to the prevailing geological conditions, and the mining system to be used at the mine. Additional measures shall be taken to protect persons if unusual hazards are encountered.

## **GENERAL MINING**

1. What action should a miner take if he knows that a fellow worker or official is smoking underground?
  - a. He should inform the foreman of whatever facts that are in his possession.
2. What should be done when gas is discovered?
  - a. The men should be withdrawn from the affected area, the power should be cut off from the section and the gas should be removed.
3. Who should supervise the removal of unusual, dangerous quantities of methane?
  - a. A certified mine official or State mine inspector.
4. To whom should unusual accumulations of methane be reported?
  - a. The appropriate mine inspector.
5. What should be required in working places and roadways as to standing gas?
  - a. They should be kept free from standing gas.
6. Should anyone enter abandoned workings alone?
  - a. No; he should be accompanied by at least one other person.
7. What should be done before employees are permitted to enter idle or abandoned sections?
  - a. The sections should be examined by a certified official.
8. From what dangers is protection required in unused or abandoned parts of a mine?
  - a. Dangers of accumulations or overflow of dangerous gases.
9. How should all unused and abandoned parts of the mine be protected against the accumulations or overflow gases?
  - a. By ventilation or by proper sealing.



10. What should be done with electric power when unusual, dangerous accumulations of methane are found in any portion of a mine?
  - a. Electric power should be disconnected from the mine.
11. What should be done with electric power in a section when ventilation has failed or accumulations of methane have been removed?
  - a. The section should be thoroughly examined and pronounced safe.
12. Under what conditions should an employee be prohibited from entering a mine to perform work on idle days?
  - a. When official inspection and supervision are not provided.
13. What should be done with accumulations of gas in worked-out abandoned portions of a mine?
  - a. They should be removed as soon as possible, or the area should be effectively sealed.
14. What is the generally accepted theory of the origin of coal?
  - a. It is the product of partial decomposition of vegetable matter without free access to air, and under the influence of moisture and pressure.
15. What are the general ingredients of coal?
  - a. Moisture, fixed carbon, volatile matter.
16. What are the principal heat-producing constituents of coal?
  - a. Fixed carbon, volatile matter, and ash.
17. What is the volatile matter in coal?
  - a. substances which are readily gasified by increased temperatures
18. What is ash?
  - a. The part of coal other than moisture which will not burn.
19. What undesirable elements exist in coal in varying small quantities?
  - a. Sulphur and phosphorus

20. Why is sulfur undesirable in coal?
- a. It corrodes metal when burned, often causes clinkers, and affects the quality of iron when coke containing sulphur is used.
21. What is the average weight of solid coal per cubic foot?
- a. About 80 pounds
22. How many net tons (2,000 lbs) are generally considered to be in a foot-acre?
- a. Approximately 1,800 tons
23. What is a BTU?
- a. British thermal unit – the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit (1 degree F) at sixty-two degrees Fahrenheit (62 degrees F)
24. What is the heating value of coal usually expressed?
- a. By the number of BTU per pound

## **VENTILATION**

- **Main mine fan examinations and records.**
- (a) To assure electrical and mechanical reliability of main mine fans, each main mine fan and its associated components, including devices for measuring or recording mine ventilation pressure, shall be examined for proper operation by a trained person designated by the operator. Examinations of main mine fans shall be made at least once each day that the fan operates, unless a fan monitoring system is used. No examination is required on any day when no one, including certified persons, goes underground, except that an examination shall be completed prior to anyone entering the mine.
  - (c) At least every 31 days, the automatic fan signal device for each main mine fan shall be tested by stopping the fan.

– **Air quality.**

- (a) The air in areas where persons work or travel, except as specified in paragraph (a)(2) of this section, shall contain at least 19.5 percent oxygen and not more than 0.5 percent carbon dioxide, and the volume and velocity of the air current in these areas shall be sufficient to dilute, render harmless, and carry away flammable, explosive, noxious, and harmful gases, dusts, smoke, and fumes.
  - (2) The air in areas of bleeder entries and worked-out areas where persons work or travel shall contain at least 19.5 percent oxygen, and carbon dioxide levels shall not exceed 0.5 percent time weighted average and 3.0 percent short term exposure limit.
  - (b) Notwithstanding the provisions of §75.322, for the purpose of preventing explosions from gases other than methane, the following gases shall not be permitted to accumulate in excess of the concentrations listed below:
    - (1) Carbon monoxide (CO)--2.5 percent
    - (2) Hydrogen (H(sub)2)--.80 percent
    - (3) Hydrogen sulfide (H(sub)2S)--.80 percent
    - (4) Acetylene (C(sub)2H(sub)2)--.40 percent
    - (5) Propane (C(sub)3H(sub)8)--.40 percent
    - (6) MAPP (methyl-acetylene-propylene-propodiene)--.30 percent

– **Mine ventilation plan; submission and approval.**

- (a)(1) The operator shall develop and follow a ventilation plan approved by the district manager. The plan shall be designed to control methane and respirable dust and shall be suitable to the conditions and mining system at the mine. The ventilation plan shall consist of two parts, the plan content as prescribed in §75.371 and the ventilation map with information as prescribed in §75.372. Only that portion of the map which contains information required under §75.371 will be subject to approval by the district manager.

1. What is the purpose of mine ventilation?

- a. To provide sufficient pure air to the employees and to dilute, render harmless, and carry away all the dangerous and noxious gases.

2. How many openings are necessary to provide adequate ventilation?
  - a. At least two (2)
3. What maximum number of men may be employed in a mine before ample ventilation is required?
  - a. Ample ventilation is required in all mines where one or more men work.
4. How should mine ventilation be obtained?
  - a. By the use of fans, mechanically operated.
5. When should a mine be ventilated?
  - a. Continuously throughout its operation life.
6. Why should a mine be ventilated continuously?
  - a. A stoppage of the ventilating current may permit the accumulation of dangerous or noxious gases.
7. What is the minimum amount of oxygen in air permitted to be delivered to working places?
  - a. Nineteen and one-half (19.5%) percent.
8. Where should ventilation in the section of a mine be directed?
  - a. To the faces and other active areas.
9. How is a mine ventilated?
  - a. By coursing the air through the intake airways to the working faces and returning it to the outside by the return airways.
10. What are the main requirements of an intake opening?
  - a. That it be unobstructed, fireproof, and located away from the possible sources of contamination to the air.
11. What are the main requirements of airways?
  - a. That they are of sufficient area and kept free of obstructions.
12. How can adequate ventilation be best circulated?
  - a. By a multiple entry system.

13. What is a common fault of the double entry system?
  - a. Insufficient area and falls restrict the volume and increase the resistance.
14. How is the ventilation current controlled?
  - a. By the use of stoppings, doors, overcasts, regulators, check curtains, and line brattices.
15. What are the main requirements of breakthroughs?
  - a. That they be kept open for persons to travel and of sufficient area to maintain adequate ventilation.
16. Through what portions of the mine should the air current not be permitted to pass before reaching working places?
  - a. Through abandoned workings not regularly inspected.
17. What means should be used to insure ventilation at faces where unusual quantities of gas or smoke may exist?
  - a. Line brattice or other approved methods of ventilation should be used.
18. Why should idle dead-end places not be permitted?
  - a. Ventilation is uncertain and gas may accumulate.
19. Where is it prohibited to turn rooms?
  - a. In advance of the ventilation current (in by last open crosscuts).
20. How should pillar lines be ventilated?
  - a. By keeping the ventilating current along the pillar line where coal is being mined.
21. When men are discovered working in places in advance of air currents, what action should be taken?
  - a. Such men should be withdrawn immediately.
22. At what points should the ventilating current be measured?
  - a. The main return, last open crosscuts in active sections, and at the beginning of pillar lines.

23. What attention should be given to ventilation equipment, controls, airways, and travel ways?
- Regular inspections and written records should be kept.
24. In the event a ventilating system fails, what action should be taken?
- The approved ventilation interruption plan should be followed.
25. What action should be taken before men are permitted to return into a mine after failure of the ventilating system?
- The mine ventilation should be restored and the mine carefully examined and reported safe by a qualified person.
26. While men are employed to provide the necessary amount of air, what other persons are permitted to enter that part of the mine affected?
- No person, except those actually employed in the necessary repair work.
27. When should changes in ventilation be made?
- When the mine is idle.
28. What is the danger of not having sufficient velocity on haulage and travelways in a gassy mine?
- The ventilation may not sweep gas out of pockets in the roof or other places such as refuge holes.
29. What is the disadvantage of permitting intake air to pass by seals before ventilating active parts of a mine?
- Where possible seals should be on return air or separate splits as failure of the seals may permit dangerous gases to be carried to the active workings.
30. How should inside substations, transformer stations and battery charging stations be ventilated?
- By a separate air current direct to the return.
31. What is the speed of a ventilating current called?
- The velocity.

32. Why should excessively high velocities in a mine be avoided?
- High velocities increase the necessary ventilating pressure and power consumption, keep coal dust in suspension, and may cause discomfort to the workers.
33. Why should extremely low velocities be avoided?
- Low velocities will not properly sweep out the gases.
34. What is the greatest single factor influencing air velocity, pressure and resistance?
- Irregular, congested airways.
35. How may high velocities be avoided?
- By the use of airways of adequate cross-sectional area and by splitting the air current.
36. For efficient ventilation, what should be the maximum velocity in airways?
- About five hundred (500) feet per minute.
37. What must be overcome to pass a ventilating current through a mine?
- The mine resistance
38. What is mine resistance?
- The resistance of the surfaces, bends, and obstructions in the airways to the passage of air.
39. What factors determine mine resistance?
- The area, perimeter, length and condition of airways plus the velocity of the ventilating current.
40. How does the mine resistance vary in relation to the velocity?
- The resistance varies directly as the square of the velocity. (For instance, if the air speed is doubled the resistance increases four times.)
41. What effect do constricted airways have upon mine resistance?
- Constricted airways increase resistance by offering a greater proportion of rubbing surface for the effective area and by requiring increased velocity for a given quantity of air.

42. What effect do constricted airways have upon velocity when the volume of air remains constant?
- a. The velocity is increased in inverse proportion to the area.
43. What is ventilating pressure?
- a. The velocity pressure is the pressure which must be exerted upon an air current to overcome the mine resistance.
44. How is the ventilating pressure measured?
- a. With water gages or continuous recorders.
45. How is ventilating pressure produced by fans?
- a. By the speed at which the fan is operating (varying with the characteristics of the fan).
46. What effect does obstructions in airways have upon the quantity of air circulated and the fan speed remaining constant?
- a. The quantity is decreased.
47. What effect does short circuits have upon the quantity of air circulated and the fan speed remaining constant?
- a. The quantity is increased out-by the point of the short-circuit.
48. What is meant by splitting the ventilating current?
- a. Dividing the main current into separate individual currents.
49. What is an air split?
- a. A portion of the main ventilating current forming a continuous current throughout a definite part of the mine.
50. What effect does splitting of an air current have on the resistance?
- a. The resistance is decreased but it should be remembered that a given volume of air can be split too many times.
51. What effect does a decrease in mine resistance have upon the performance of a fan?
- a. The fan is enabled to circulate an increased quantity of air with no increase in the ventilating pressure.



52. What if the benefit of decreased mine resistance when it is not necessary to increase the quantity of air in circulation?
- A saving in power can be effected by reduced fan speed.
53. What effect does high humidity and high temperature have upon persons working?
- The temperature of the body cannot be dissipated by the evaporation of perspiration and such conditions cause discomfort to the workers.
54. What are the two systems of ventilation?
- Blowing (force) and exhaust.
55. How can the main hallway of a mine be placed on fresh air when the mine is ventilated by a force system?
- By the use of airlocks or by placing on a separate split.
56. What is the advantage of having the main hallway on the intake in the event of an explosion or fire?
- Usually, entrance to the mine is more easily obtained.
57. What is the main disadvantage of having the intake near the dumping point?
- Dust from the dumping point is frequently carried into the mine.
58. What may be the disadvantage of having the mine shaft or slope on the intake during cold weather?
- Freezing temperatures may interfere with operation.
59. What may be the disadvantage of having workers on the return in a gassy mine?
- The return may contain an explosive mixture of gas.
60. On what air current is it generally recommended that haulage roads be placed?
- Usually on intake air.

## **Water Gauge**

1. What is a water gauge?
  - a. AN instrument to determine differences in air pressure.
2. Of what does a water gauge consist?
  - a. The water gauge consists of a glass U tube partially filled with water and open at both ends.
3. How is a water gauge used to determine differences in air pressure?
  - a. By connecting the ends of the tube to the points between which the difference is to be measured.
4. How is ventilating pressure determined by the water gauge?
  - a. By the difference in elevation of the two water columns.
5. How is the water gauge graduated?
  - a. In inches and tenths thereof.
6. What pressure is denoted by each inch difference in the level of the water columns?
  - a. 5.2 pounds per square foot.
7. What are the principal requirements for permanent stoppings?
  - a. They should be alright, and substantially built.
8. What effect do leaky stoppings have upon ventilation costs?
  - a. Costs are increased due to waste of the air.
9. As a mine deepens what effect will it have on leaky stoppings?
  - a. The increased pressure will cause the stoppings to lose more air.
10. In what way do leaky stoppings increase the cost of ventilation?
  - a. By requiring the fan to move a greater quantity of air necessary to properly ventilate the working faces.
11. What is the economical effect of airtight stoppings?
  - a. Costs are decreased by an increase in ventilating efficiency.

12. When and where should brattice cloth stoppings be used?
  - a. Only temporarily, in next to the last open breakthrough.
13. How can the ventilation of large abandoned areas be avoided?
  - a. By sealing them.
14. What should be done when conveyors are extended through stoppings?
  - a. They should be boxed to prevent excessive air leakage.

## **Line Brattice**

1. What is a line brattice?
  - a. It is a curtain erected from the last breakthrough, along the entry or room, to the face.
2. What is the purpose of a line brattice?
  - a. To direct an air current to the working face.
3. What materials are used for line brattices?
  - a. Flame resistant materials.
4. When brattice cloth is used, what precautions should be taken against fire?
  - a. The brattice cloth should be nonflammable.
5. What is the purpose of a line brattice?
  - a. To assure a sufficient velocity of air at the face to remove dangerous gases and smoke from explosives and to control float mine dust.
6. How should the space behind the line brattice be maintained?
  - a. Clean and open for the free flow of air.

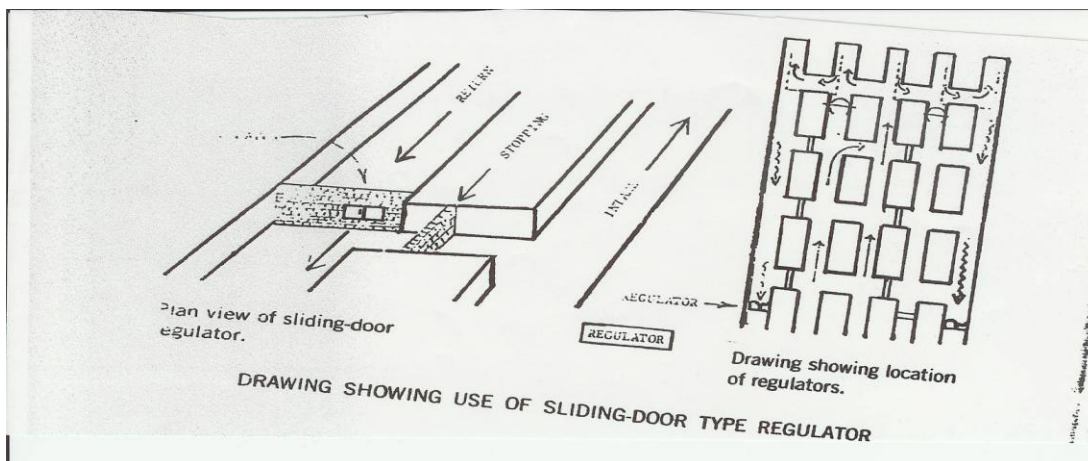
## **Doors**

1. What is the purpose of ventilating doors?
  - a. To direct the course of the ventilation and permit traffic to pass

2. Why are doors in a mine objectionable?
  - a. If damaged or left open they permit short-circuiting of the air; they permit leakage, and unless built of incombustible material, they constitute a fire hazard.
3. How should a door be hung?
  - a. So that it will close automatically and tightly.
4. What provision should be made to prevent a short circuit of a main ventilating current controlled by doors?
  - a. Doors should be hung in pairs to form air locks.
5. How far apart should the doors of an air lock be placed?
  - a. A sufficient distance to accommodate a full trip of cars.
6. When are doors advisable?
  - a. When it is impracticable to use overcasts.
7. If a serious explosion of methane occurred in a mine which was normally well ventilated, what would be the probable cause?
  - a. Interrupted ventilation.
8. Should haulage equipment be permitted to stand in doors or curtains?
  - a. No.
9. Is the use of automatic doors preferable to ordinary doors?
  - a. Yes, but they should be inspected regularly and kept in operating condition.
10. In which direction should doors swing to close?
  - a. In the direction of the air current so the pressure will keep the door closed.
11. Why should latches on doors be prohibited?
  - a. Doors should not be provided with any device to prevent their closing.
12. What are the main requirements of an overcast?
  - a. To provide sufficient area for the air current and to permit a smooth, uninterrupted flow of air.

13. What are some of the common errors made in constructing overcasts?
  - a. Rough and abrupt interruption to the ventilating current, and insufficient area.
14. How do overcasts aid haulage?
  - a. They eliminate the necessity for doors on the haulage road.
15. How do overcasts aid ventilation?
  - a. They permit frequent splitting of the air and provide for uninterrupted ventilation.

## Regulators

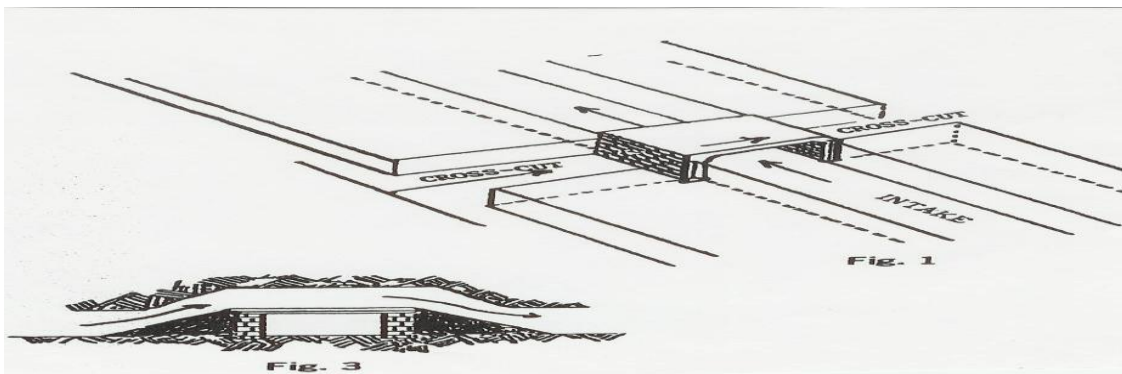


1. What is a regulator?
  - a. An adjustable partial obstruction in an airway.
2. What is the purpose of a regulator?
  - a. To control the distribution of the air by regulating the resistance to flow of an air split.
3. How is a regulator usually constructed?
  - a. It usually is a stopping provided with an opening having a sliding door.
4. What is the effect of a regulator on the amount of air entering a split?
  - a. The regulator serves as a valve to decrease or increase the amount as desired.

5. Why are regulators essential to the ventilation of a mine?
  - a. They proportion the air to meet the requirements of each individual split.
2. Who determines where regulators are placed?
  - a. Mine management.
3. What types of regulators are used?
  - a. The slide and the door type.
4. Where are the regulators usually placed in a mine?
  - a. usually at the return ends of the splits.

## **Overcast**

An overcast is a form of a bridge which permits air current to pass over another. Overcasts are normally built in an intersection opposite a break-through. An overcast permits frequent splitting of the air – allowing air to pass only over one section or one portion of a mine. It also aids the haulage of a mine because it eliminates the necessity for doors. The common errors made in the construction of an overcast are: rough and abrupt interruption to the ventilating current, and insufficient area. The area on the inside of the overcast which abuts up against the construction should be filled in with material and smoothed down so that air will flow easily over the top of the overcast. The distance from the top of the overcast to the roof should be of sufficient area to allow air to pass freely.



1. What is an overcast?
  - a. It is an enclosed airway constructed to provide a means for one air current to cross another.
2. How should overcasts be constructed?
  - a. They should be airtight and substantially constructed of incombustible material.
3. What is the minimum number of entries required where belt conveyors are used?
  - a. Not less than three (3).
4. Why must there be at least three (3) entries when belt conveyors are used?
  - a. One entry is for intake air, one for the return and the belt entry must be on a neutral split.

## **ELECTRICAL**

- **Installation of high-voltage transmission cables.**
  - All underground high-voltage transmission cables shall be installed only in regularly inspected air courses and haulageways, and shall be covered, buried, or placed so as to afford protection against damage, guarded where men regularly work or pass under them unless they are 6 1/2 feet or more above the floor or rail, securely anchored, properly insulated, and guarded at ends, and covered, insulated, or placed to prevent contact with trolley wires and other low-voltage circuits.
- **Electrical connections or splices; suitability.**
  - All electrical connections or splices in conductors shall be mechanically and electrically efficient, and suitable connectors shall be used. All electrical connections or splices in insulated wire shall be reinsulated at least to the same degree of protection as the remainder of the wire.

## **PRACTICAL MINING STATEMENTS**

- ☐ Three elements must be present for an explosion to occur: fuel, oxygen, and heat (ignition).
- ☐ Permanent seals should be well hitched in the roof, floor, and ribs to make them as airtight as possible.
- ☐ Electrical fires are best extinguished by nonconducting agents such as carbon dioxide and certain dry chemicals.
- ☐ “Class A” fires are best extinguished by cooling with water or by blanketing with certain dry chemicals.
- ☐ Hydrogen can be liberated when water or steam comes in contact with hot carbon materials.
- ☐ All conductive objects such as cables, track, trolley wire, water lines, belt structures, etc. extending into the explosion area should be severed or removed at or out by the fresh air base before explorations are started.
- ☐ Explosions in coal mines are most often caused by ignitions of methane, coal dust, or combination of the two.
- ☐ An indication of an explosion may be a jump in the pressure recording chart for the main fan.
- ☐ Gas readings must be taken in the returns near the fire area to determine if the mine atmosphere is potentially explosive.
- ☐ Seals in high volatile coal beds are often placed 1,000 feet or more from the fire area.
- ☐ When sealing a mine fire, you should be careful to ensure that there are no abrupt changes in the ventilation over the fire area.
- ☐ Copper tubes or pipes are inserted in temporary and permanent seals for the purpose of collecting air samples from the sealed area.



- ☐ Before going underground to explore for a fire or to fight a fire, the team should know about any possible ignition sources that may exist in the affected area.
- ☐ In potentially explosive atmospheres, nonsparking tools, nails, and spades should be used.
- ☐ Carbon monoxide is a product of incomplete combustion of any carbon material.
- ☐ Small hydrogen explosions, known as hydrogen “pops” are fairly common in firefighting.
- ☐ Explosions, fires, and other disasters frequently result in weekend roof and rib conditions.
- ☐ Regulators are used in mine ventilation to regulate airflow to meet the individual needs of each air split.
- ☐ Overcasts are used to permit two air current to cross without the intake air short circuiting to the return.
- ☐ The lower explosive limit of carbon monoxide is 12.5 percent .
- ☐ The basic principle of mine ventilation is that air always moves from high to low pressure regions.
- ☐ The most positive indicator of the origin of an explosion in the direction in which blocks have moved in or from stopping across entries near intersections.
- ☐ .Coking or coke streamers, if encountered, should be reported in location and size.
- ☐ Afterdamp consists of carbon monoxide, nitrogen, smoke , and low oxygen.
- ☐ All detectors should be checked for battery charge, zeroed in fresh air, and any physical damage.

## **FUNDAMENTAL FORMULAS**

In order to have a more complete understanding of mine ventilation, there are certain fundamentals and calculations that are necessary. For all practical purposes the following eight (8) formulas should suffice:

$$Q = AV$$

$$P = R$$

$$p = 5.21$$

$$Hp = \frac{PV}{33,000}$$

$$P = pA$$

$$I = \frac{P}{5.2}$$

$$P = \text{Total Pressure}$$

$$S = LO$$

$$R = KLOV^2$$

In Which:

A = Area of airway

Q = Quantity or volume

P = Total Pressure

O = Perimeter of airway

K = Coefficient of friction

V = Velocity, ft. per min.

p = Pressure in lbs. Per sq. ft.

L = Length of airway

Hp = Horsepower

i = Inches water gage

S = Rubbing surface

R = Resistance

## **AREA**

A – The area of an airway is obtained by multiplying its width by its height. If an air passage has a width of 12 ft. and a height of 5 ft., then  $(12 \times 5) = 60$  sq. ft.

## **LENGTH**

L – The actual length measurement of an airway in feet.

## **PERIMETER**

O – The perimeter of an airway is found by adding the four sides together. For an airway measuring 12 ft. x 5 ft., the perimeter is  $12 + 12 + 5 + 5$  or 34 ft.

## **RUBBING SURFACE**

S – the rubbing surface of an airway is obtained by multiplying its perimeter by the length. What is the rubbing surface of an airway 12 ft. by 5ft. having a total length of 5,000 ft.? The perimeter is 34 ft. (see preceding solution); and the rubbing surface is  $34 \times 5,000$  or 170,000 sq. ft.

## **VELOCITY**

V – The average velocity of air in linear feet per minute as read with an anemometer over a sectional area of the air course.

## **QUANTITY OR VOLUME**

Q – The volume of air passing through the mine. It is obtained by multiplying the sectional area of the airway in square feet by the velocity indicated by the anemometer in feet per minute. If a velocity of 500 ft. per min. is registered in sectional area of 60 st. ft. then  $(60 \times 500) = 30,000$  cu. ft. Per min.

## **PRACTICE EXAMPLES**

Using the formula  $Q = AV$ , if the area of an airway is 50 square feet and the velocity as shown by the anemometer is 500 lineal feet per minute, then the quantity would equal 25,000 cubic feet per minute.

$$Q = AV$$

$$Q = 50 \text{ ft. area} \times 500 \text{ ft. velocity}$$

$$Q = 25,000 \text{ cubic feet per minute}$$

Using the formula  $p = 5.2i$ , if the water gage reading is 3 inches, then

$$p = 5.2i$$

$$p = 5.2 \times 3 \text{ inches water gage}$$

$$P = 15.6 \text{ pounds pressure per square foot}$$

Formula  $P = pA$  is used to find the total pressure exerted against the air to move it through the mine. For instance, if the pressure per square foot is 15.6 and the area of the is 50 square feet then,

$$P = pA$$

$$P = 15.6 \times 50$$

$$P = 780 \text{ pounds total pressure}$$

Using the formula  $S = LO$ , it is necessary to find the rubbing surface of a mine airway before the resistance can be calculated because it is against the surface that the air must rub while passing through the mine. For instance, if we substitute length of an airway equal to 5,000 feet and with a perimeter of 50 feet, then

$$S = LO$$

$$S = 5,000 \times 50$$

$$S = 250,000 \text{ sq. ft. of surface the air would rub against}$$

## **FORMULAS TO KNOW TO DILUTE GASES**

To find percentages (%) of methane when the cubic feet and the total volume are known, divide the cubic feet of methane by the volume.

To find the cubic feet of methane when the percentages (%) of methane and the total volume are known, multiply the volume by the percentage.

To find the total volume of air when the percentages (%) and the cubic feet of methane are given, divide the cubic feet of methane by the percentage.

### **EXAMPLE PROBLEMS**

If the return current of a mine is 30,000 cubic feet a minute and contains 8% of methane, how much air must be added to reduce the methane to 3%?

$$\begin{aligned} 30,000 \times .08 &= 2400\text{cfm} \\ 2400 \text{ divided by } .03 &= 80,000\text{cfm} \\ 80,000 - 30,000 &= \text{Answer} \\ 50,000\text{cfm} \end{aligned}$$

If split of air has 20,000 cubic feet of air a minute and the methane content is 5% a minute how many cubic feet of methane is liberated per minute?

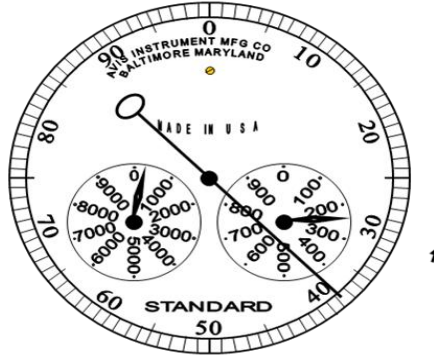
$$\begin{aligned} 20,000 \times .05 &= \text{Answer } 1000 \\ \text{cubic feet per minute} \end{aligned}$$

What is the percentage of methane in an air course which has a volume of air of 10,000 cubic feet per minute and 80 cubic feet of methane?

$$\begin{aligned} 80 \text{ divided by } 10,000 &= .008 \\ \text{Change } .008 \text{ to percentage} &= \\ \text{Answer } .8\% \text{ methane} \end{aligned}$$

# Anemometers

**Take care to record correct dial reading.**



Dial Reading = 239 feet per minute.

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## **COAL MINING REFERENCE BOOK (Anemometer)**

The form of anemometer generally used in coal mining consists of a metal ring within which is set a rotating propeller or blade. The air current striking the inclined blades rotates the vane, the number of revolutions being recorded on the face of the dial by means of a series of gears. The instrument is so calibrated that each revolution of the vane corresponds to one lineal foot of air travel. The instrument is employed to measure the velocity of the air current in mine airways as expressed in feet.

In taking a reading a place is first found where the air has a straight course and will not be deflected unequally to either side, and where the area of the airway can be measured.

Hold the anemometer at arm's length in such a way that the blades will turn in a plane at right angles to the air current. Using the reset lever on the anemometer, so all dial hands will be on zero, the brake lever near the handle is released and the anemometer is exposed to the air current for one full minute, moving about so as to obtain an average reading for the entire sectional area of the airway after which the brake is applied. (The reading of the anemometer times the area of the airway in square feet gives the quantity of air passing in cubic feet per minute.)



# **COAL MINING REFERENCE BOOK**

**1. Q. What is an anemometer?**

**A. An instrument resembling a small disk fan used to measure lineal feet of air travel.**

**2. Q. How are air velocities determined by an anemometer?**

**A. By the lineal feet of air travel as recorded on the dials by the revolutions of the fan shaft.**

**3. Q. How is an anemometer graduated?**

**A. To record the lineal feet of air travel.**

**4. Q. For what period of time are mine air velocities determined?**

**A. Usually for one minute.**

**5. Q. How is an anemometer used to obtain velocities in mines?**

**A. It is held in an air current for a given period of time to determine lineal feet of air travel.**

**6. Q. In which direction should the air current pass through the anemometer?**

**A. The air current should enter the back of the anemometer.**

**7. Q. Why should the anemometer be moved across the airway while taking the reading?**

**A. So that the average reading may be obtained.**

**8. Q. What is the purpose of the reset on the anemometer?**

**A. To set dials at zero.**

**9. Q. What is the purpose of the clutch on the anemometer?**

**A. To engage or disengage the dial gears.**

**10. Q. What three instruments are necessary to get an air reading?**

**A. Anemometer, watch and measuring tape.**



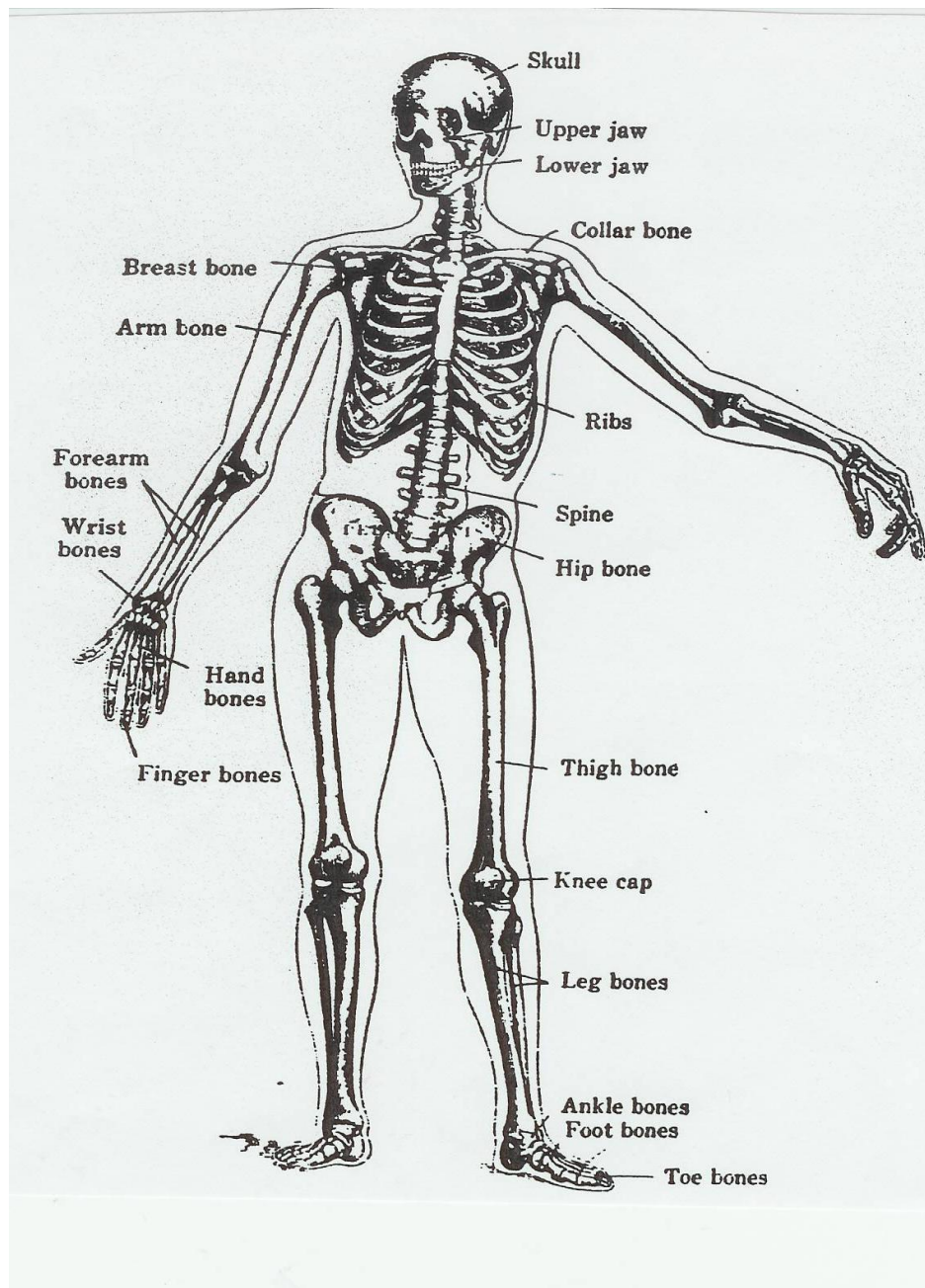
# BAROMETER

1. Q. What is a barometer?
  - a. An instrument for determining atmospheric pressure or elevation.
2. Q. What are the two common types of barometers?
  - a. The mercurial barometer and the aneroid barometer.
3. What is the principle by which a mercurial barometer operates?
  - a. Atmospheric pressure is determined by the height to which a mercury column is raised in vacuum.
4. How does the aneroid barometer operate?
  - a. The movement of one side of the instrument, which rises or falls as the outside pressure changes, is shown on the dial, which is graduated in inches of mercury column and in feet indicating elevation.
5. What is atmospheric pressure?
  - a. The pressure exerted by the column of air above a given point.
6. What is the normal pressure of air on the earth's surface at sea level?
  - a. About 14.7 pounds per square inch.
7. What is the barometer reading for normal air pressure at sea level?
  - a. Thirty (30) inches.



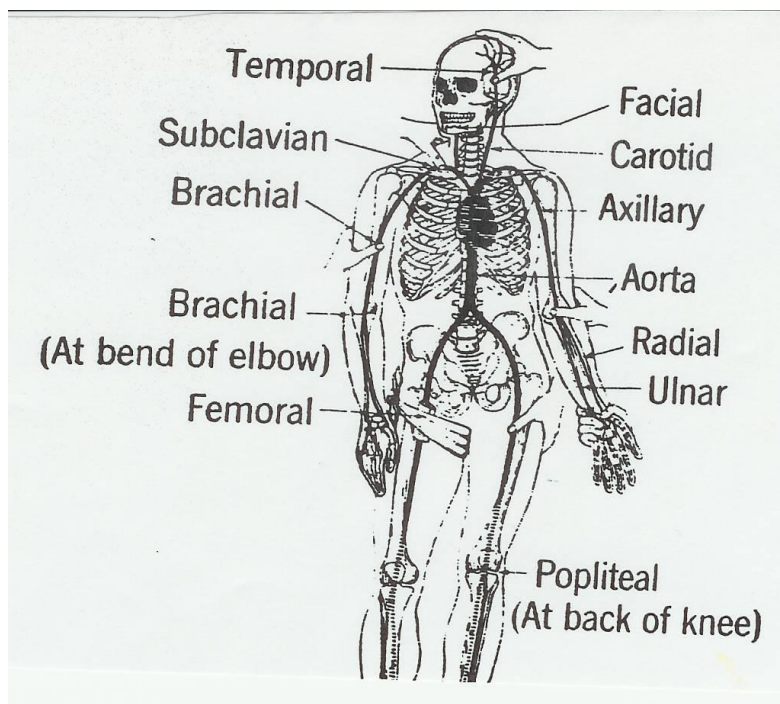
# **FIRST AID TO THE INJURED**

1. Into what three parts is the body divided for first aid?
  - a. The body is divided into the head, the trunk, and the extremities.
2. Approximately how many bones compose the adult human skeleton?
  - a. Approximately 200 bones.



# **COAL MINING REFERENCE BOOK**

1. What amount of blood lost by an adult is liable to prove serious?
  - a. The loss of 1 or 2 pints of blood by an adult is usually serious.
2. What amount of blood lost by an adult is liable to prove fatal?
  - a. The loss of 2 or 3 pints of blood may prove fatal.
3. What safeguard has nature provided to check bleeding?
  - a. The blood flowing from the body is a fluid; but as soon as a blood vessel is cut, nature provides a safeguard in the form of thickening and clotting of the blood at the site of the wound, which tends to stop the flow.
4. Who are “bleeders”?
  - a. The blood of some persons will not clot. Such persons are commonly called “bleeders” and they may bleed to death from slight injuries where blood vessels are cut.
5. Name the methods of controlling bleeding?
  - a. Digital pressure, the application of a tourniquet, direct pressure, constricting bandage, elevation, and cold applications.



# **FIRST AID REVIEW**

## **What are the signs of a heart attack?**

- ☐ Shortness of breath
- ☐ Nausea
- ☐ Sweating
- ☐ Pale ashen skin
- ☐ Chest pains lasting longer than 3 to 5 minutes

## **The cycle for CPR is:**

- ☐ Hand position – two hands in center of chest (on lower half of sternum)
- ☐ At least 2 inches chest compressions depth
- ☐ Cycle 30 compressions 2 breaths (or just compression for non trained rescuer)
- ☐ Compressions rate of at least 100 per minute
- ☐ Carotid pulse is taken in the neck area to the side of the adams apple

## **Dislocating and fractures:**

- ☐ **What is a dislocation?** A dislocation is slipping out of normal position of one or more bones forming a joint.
- ☐ **What other injuries usually accompany a dislocation?** Torn and stretched ligaments.
- ☐ **What is the general treatment for dislocations?** Applying dressings, and in some instances splints, so that the parts are immobilized in the line of deformity in which they are found.

## **Burns:**

- ☐ **First degree** – involve only the top layer of skin, the skin is red and dry.
- ☐ **Second degree** – deeper than first degree burns, skin will look red and have blisters. Skin will appear wet if blisters are broken.
- ☐ **Third degree** – burns extend through the skin and into the structures below the skin. These burns may look brown and charred or black. The tissues underneath may look white.

## Fractures:

- ☐ Fractures are breaks or cracks in the bones.
- ☐ They are defined as open or closed. Closed fractures, the skin is not broken and Open fractures, the skin is broken.

## Signals of fractures and dislocations:

- ☐ Pain
- ☐ Swelling
- ☐ Deformity
- ☐ Discoloration
- ☐ Bruising of the skin
- ☐ Inability to use affected part

***First Aid is emergency care or treatment given to an ill or injured person before regular medical aid can be obtained.***

## What are the 6 fundamentals of first aid?

- ☐ Artificial Respiration (CPR)
- ☐ Control of bleeding
- ☐ Treatment of shock
- ☐ Caring for open wounds and burns
- ☐ Treatment of dislocation and fractures
- ☐ Transportation of the injured

## Give four reasons for breathing to stop?

- ☐ Drowning
- ☐ Electrocution
- ☐ Heart Disease
- ☐ Poisoning

## What action would you take if a victim stops breathing?

- ☐ Call for help
- ☐ Check pulse
- ☐ Start CPR

## Define bleeding from the following:

- ☐ Artery      Spurting blood, bright in color
- ☐ Capillary    Blood oozing from a wound
- ☐ Vein        Continuous flow of blood, dark red in color

## **Controlling Bleeding:**

- ☐ A tourniquet is a wide band of cloth or other material placed just above the wound to stop all flow of blood. A tourniquet should only be used as a last resort when the appropriate pressure point fails to stop the bleeding.
- ☐ A pressure point is a place on the body where an artery passes directly between the outer skin and a bone. Thereby applying pressure at this point will reduce the flow of blood. There are 22 pressure points, 11 on each side of the body.
- ☐ A compress bandage is a bandage applied directly over the wound in order to control bleeding.

**What would you do if a person had a compound fracture between the knee and foot and bright red blood was spurting?**

- ☐ Call for help
- ☐ Make sure the area is safe
- ☐ I would make the victim as comfortable as possible and would not move him unless absolutely necessary. I would then apply direct pressure to the arterial bleeding with a compress bandage and treat for shock. If bleeding was not controlled, I would apply immediate temporary pressure between the open wound and the heart to stop the bleeding.
- ☐ I would next carefully support the leg and immobilize it by using a rigid or an air splint. Carefully load the patient onto a stretcher, transport him to an ambulance for transportation to the nearest medical facility for medical attention.

**What are the signs and symptoms of “Shock”?**

- ☐ Cold, clammy, moist skin (profuse sweating)
- ☐ Pale face, dull chalklike skin
- ☐ Shallow, labored rapid or gasping breathing
- ☐ Weak, rapid pulse



	Hydrogen Sulfide	Methane	Carbon Dioxide	Nitrogen	Oxygen	Carbon Monoxide	Hydrogen
Origin	Rarely found old pipelines in poorly ventilated areas	Occluded in Coal and decomposition of vegetation in water	Complete combustion Small quantity found naturally in air	Found naturally in air	Found naturally in air	Incomplete combustion Mine fires & explosions Blasting	Charging of batteries, mine fires, explosions
Chemical Symbol	H <sub>2</sub> S	CH <sub>4</sub>	CO <sub>2</sub>	N <sub>2</sub>	O <sub>2</sub>	CO	H <sub>2</sub>
Explosive Range	4.3 - 46%	5 - 15%	None	None	None	12.5 - 73%	4.0-74%
Effect on Life	.07% causes death in one hour. Destroys olfactory nerves	Death by suffocation	Death by suffocation	Death by suffocation	Necessary for life	.10% in air causes complete collapse Occludes oxygen from the blood	Inert
Detection	Multi-gas detector Odor Chemical analysis	Multi-gas detector Chemical analysis	Chemical analysis	Chemical analysis Multi-gas detector	Chemical analysis Multi-gas detector	Chemical analysis Multi-gas detector	Chemical analysis Multi-gas detector
Specific Gravity	1.191	0.555	1.5291	0.967	1.105	0.967	0.07
Ignition Temperature	700 degrees	1100 - 1380 Degrees	None	None	None	1100 degrees	935 degrees

